

PROBLEM-BASED EDUCATIONAL GAME BECOMES STUDENT-CENTERED LEARNING ENVIRONMENT

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ABSTRACT

Problem-based educational games are able to provide a fun and motivating environment for teaching and learning of certain subjects. However, most educational game models do not address the learning elements of problem-based educational games. This study aims to synthesize and to propose the important elements to facilitate the learning process and problem solving skill in game-based learning from selected education game models and a problem-based learning model. The results showed two critical components were 1) pedagogy and 2) design embedded in game-based learning and three significant characteristics of a problem-based educational game were 1) authentic problems, 2) student-centered activity, and 3) a facilitator. This paper focuses on proposing and discussing components that leverage the pedagogical aspects in designing a problem-based educational game environment. Moreover, other developers can use this pattern to facilitate to be student-centered learning environment.

KEYWORDS

Problem-based educational games, game-based learning, game design, student-centered learning

1. INTRODUCTION

The digital games concept has been used in education since the end of the 20th century because games have the potential to promote the student' skills through problem solving. This paradigm, known as game-based learning, was one in which Conati (2002) identified games utilization as a medium for conveying the learning content. Gee (2003) defined educational games as games that emphasize learning and designing to teach humans about a specific subject, and to teach them a skill. Game-based learning is similar to problem-based learning, that specific problem scenarios are placed within a play framework (Barrows & Tamblyn, 1980). Problem-based learning can provide a student-centered learning approach (Walker and Shelton, 2008).

As Barab et al. (2005) described, educational digital games could draw students' attention and allow them to develop their experience and cognition through the games. Instructional designers and game developers should consider more the pedagogical basis of a game. Real learning does happen in games, and the learning engaged by gamers shares many attributes with the pedagogy of problem-based learning. Players must solve problems to progress through the game. Challenging, unpredictable, and competitive digital games are the drivers of game playing (Squire et al., 2004). A digital game is a form of entertainment which has characteristics such as goal, rule, competition, challenge, fantasy, safety, interaction, problem-solving, results and feedback, as well as storyline, (Alessi & Trollip, 2001; Prensky, 2001). Buchanan (2004) insisted that digital games should be designed to support learning of cognitive, affective, and psychomotor skills abilities, problem-solving thinking skills and promote creative exploration. However, to design a game and know how to make the placement of learning content in order to achieve the instructional goal and let the players achieve knowledge is an important issue. Educators attempt to develop a complex simulated environment to nurture learners' problem-solving ability because games can be offer the situations to explore, reason, decide, and apply related abilities to similar situations in daily life.

This study aimed to propose and to synthesize important elements to facilitate the learning process and development of problem solving skills in game-based learning from the selected education game models and a problem-based learning model.

This paper is organized as follows: Section 1 provides the background of this case study; Section 2 illustrates some models for problem-based educational games; Section 3 presents some ideas and elements that a problem-based educational game should contain and the last section of this paper includes future directions following this review.

2. PROBLEM-BASED EDUCATIONAL GAME MODELS

This section discusses four selected models proposed by Amory and Seagram (Game Object Model: GOM), Song and Zhang (EMF: A Model for Education game design), Simons and Ertmer (Model of problem-based learning) and Kiili (A Problem-based gaming model) which fall into the category of problem-based educational games.

The models were analyzed based on 2 major components: (1) Pedagogical (exploration, challenges, engagement, goals, critical thinking, competition, practice, student-centered learning, motivation, and task) (2) Game Design (storyline, outcome, interaction, collaboration, facilitator, feedback, coaching and reflection, and reflection & debriefing)

Table 1. Summary Elements of Problem-Based Learning Models

Component	Pedagogical										Design						
	Exploration	Challenges	Engagement	Goals	Critical thinking	Competition	Practice	Student-centered learning	Motivation	Task	Storyline	Outcome	Interaction	Collaboration	Facilitator	Feedback	Coaching & Scaffolding
Elements Models	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Amory and Seagram (2003)	●	●	●	●	●	●	●				●	●	●			●	
Song and Zhang (2008)		●	●	●				●	●				●			●	
Simons and Ertmer (2005)		●	●	●	●			●	●		●	●	●	●	●	●	●
Kiili (2007)		●	●	●	●			●	●	●	●	●	●	●	●	●	●

Table 1 illustrates a summary matrix of the game design element for the models. All the models emphasize greatly the interaction, challenges, goals, engagement and feedback elements. However, only three models include engagement, critical thinking, motivation, Student-centered learning, and storyline. Outcome, collaboration, facilitator, coaching & scaffolding, and reflection & debriefing are some common elements shared in different combination of two models.

2.1 Game Object Model

Amory and Seagram (2003) presented a model called “Game Object Model” (GOM) which combines education theory and game design. This model consists of both pedagogical dimensions and game elements. Pedagogical elements are play, exploration, challenges, engagement, goal formation, goal competition, critical thinking, discovery, competition and practice. On the other hand, games elements that are interaction, storyline, feedback, fun, graphics, sound and technology.

GOM is the model that game designer should use when developing an educational game. It contains the pedagogical elements and game elements that can create a learning environment.

2.2 EFM: A Model for Education Game Design

Song and Zhang (2008) implemented an educational game design model for educational game design through describing motivation, flow experience and effective learning environment. This model provides some design guidelines for researchers and developers of educational games. The model includes:

1. Effective learning environment: It must provide players with the seven basic requirements, which include goals, challenge, motivation, engagement, appropriate tools, avoiding distractions, feedback, and challenge.
2. Motivation: The four essential strategy components for stimulating motivation are relevance, confidence, satisfaction and attention, which relate to the four elements which are goal, challenge, feedback and interest.
3. Flow experience: The nine dimensions of the flow experience also include goals, feedback, challenge, concentration, control, awareness, experience, time, and self-consciousness.

2.3 Model of Problem-Based Learning

This model has its foundation in the theories of student-centered learning. Simons and Ertmer (2005) pointed out that problem-based learning presents several challenges to the learner. This model ranges from limited implementation, which present a question with the teacher or facilitator to the learner. The elements of problem-based learning model are engagement, motivation, collaboration, critical thinking, student-centered learning, storyline, outcome, goals, facilitator, feedback, challenges, coaching & scaffolding, reflection & debriefing and interaction.

2.4 A Problem-based Games Model

Kiili (2007) proposed a model representing the steps for problem-based game design. The model is founded on the principles of problem-based learning. This model assumes out that there are 15 factors which must be viewed in a problem-based game i.e. engagement, challenges, goals, critical thinking, student-centered learning, motivation, authentic learning tasks, outcome, interaction, feedback, collaboration, storyline, coaching & scaffolding, and reflection & debriefing and facilitator. All the factors are closely related to the learners.

The factors covered in this model are important in designing good problem-based games. This aim of this model is to describe a general learning process in an educational game.

3. GAME DESIGN: ELEMENT FOR PROBLEM-BASED EDUCATIONAL GAME

An appropriate problem-based educational game should be developed based on some criteria which fulfill the requirement of the target learners. A part form student-centered learning, game design is another component that game designers should consider when developing problem-based educational games. Design of a problem-based educational game might affect the learning process of learners when playing the game. Thus, the design of the game is very important. From the review of the models, we suggest that the problem based educational games should have three important characteristics, i.e. authentic problem, student-centered activities, and facilitator.

3.1 Authentic Problems

Authentic problems are the central focus of instructional activities in problem based educational games. Authentic problems in educational games are designed, selected and sequenced in the way that guide student learning.

An example of presenting authentic problems would be that the problem has multiple solution paths, the problem is unsolved and ill-structured, the environment is abstracted as a design decision to support the authentic nature of task, and learning is followed up with opportunities for practice in more realistic settings.

3.2 Student-centered Activity

Problem-based educational games are a learner centered approach to education (Walker and Shelton, 2011). Specifically, the player take on responsibility for examining a problem in a game and then determining what they know and what they need to learn in order to solve it. Problem based educational games still have a responsibility for defining learning objectives, but these are mostly kept from players who generate their own learning objectives in response to a given problem. The next step is locating appropriate resources to allow investigation of areas of personal interest. Problems in a game needed to be presented prior to any pursuit of knowledge. As a final step, players are responsible for self-assessment and peer assessed problem solving performance. The examples of student-centered activity in problem-based educational game are activities that a player uses to generate objectives from given information, locate and pursue resources in a form that will assist in problem resolution, and engage in self and peer assessment of problem solving performance.

3.3 A Facilitator

Problem-based learning instructors act primarily as facilitators, a role shift that support students throughout the problem-solving process. So facilitators in problem-based educational game are in a Multi-User Virtual Environment. Within a Multi-User Virtual Environment, learner action is mediated by a progression of analysis of tasks within the environment. Progress is monitored by an instructor who provides coaching and guidance. Facilitators in problem-based educational games are designed to be an engaging way to improve educational outcomes. The examples of facilitators enable multiple participants to access virtual configured architectures, interact with digital artifacts, and communicate with other participants.

Design of the Problem based on educational games might affect the learning process of learning when learners are playing the game. Thus, the design of the Problem based educational games is important. From the review, we suggest that the Problem based educational games should contain 19 subcomponents i.e. rule, goals and objectives, storyline, feedback, competition challenge, fantasy, control, curiosity, feedback, outcome, fun, interaction, Coaching & Scaffolding, Reflection & Debriefing, Authentic problem and Facilitator in Figure 1

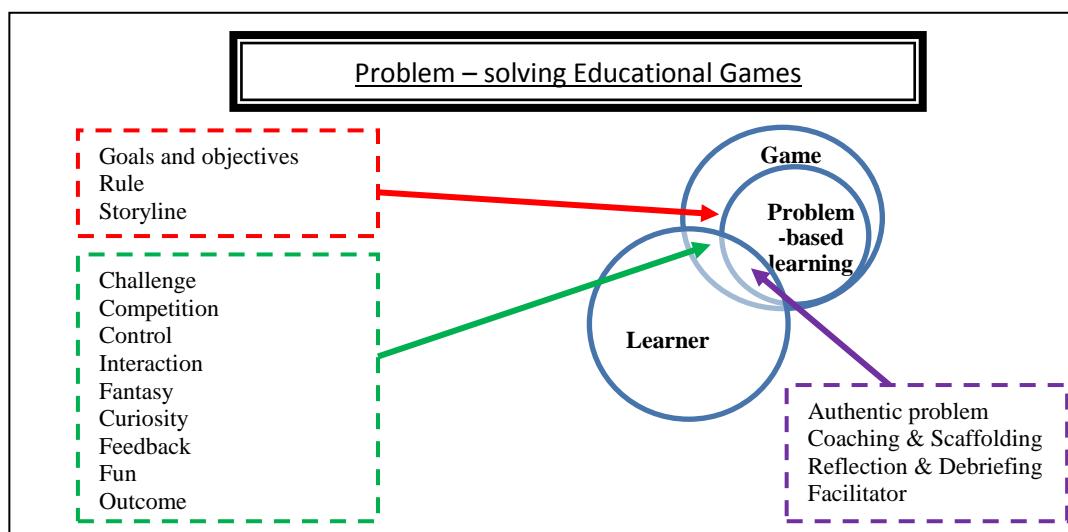


Figure 1. Element for Problem-based Educational Games

4. CONCLUSION

Educational games may offer a viable strategy for developing student's problem solving skill and so developing a good educational game for players is very important. Several models have been proposed by researchers in field of game design. However, the development of a game to be used for learning in a difference form requires game designers to look in future into the learners and learning content pedagogically.

This paper has identified the essential components based on existing models. Our thorough study of the existing models showed two critical components were pedagogy and design embedded in game-based learning and three significant characteristics of problem-based educational games were authentic problems, student-centered activity, and a facilitator. Moreover, all developers can use this pattern to facilitate to be student-centered learning environment.

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